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FINAL REPORT

FOR PERIOD FROM

12 AUGUST 1980 THROUGH 30 JUNE 1994

TO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
GEORGE C. MARSHALL SPACE FLIGHT CENTER

FROM

THE UNIVERSITY OF TEXAS AT DALLAS  
PO BOX 830688  
RICHARDSON, TEXAS 75083-0688

FOR RESEARCH UNDER

CONTRACT NAS8-33827

ENTITLED

"MEASUREMENTS OF VISIBLE AND UV EMISSIONS FROM  
ENERGETIC ATOM PRECIPITATION (ENAP)"

UNDER THE DIRECTION OF

BRIAN A TINSLEY

DECEMBER 1994

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(NASA-CR-197502) MEASUREMENTS OF  
VISIBLE AND UV EMISSIONS FROM  
ENERGETIC NEUTRAL ATOM  
PRECIPITATION (ENAP) Final Report,  
12 Aug. 1980 - 30 Jun. 1994 (Texas  
Univ. at Dallas) 3 p

Final Report on work performed under NASA support NAS8-33827;  
"Measurements of Visible and UV emissions from Energetic Neutral  
Atom Precipitation"

There are two publications from the ENAP results up to the present:

1. Middle and Low Latitude Emissions from Energetic Neutral Atom  
Precipitation seen from ATLAS 1 Under Quiet Magnetic Conditions,  
Tinsley, B. A. , R. P. Rohrbaugh, M. Ishimoto, M. R. Torr, and D.  
G. Torr, *J. Geophys. Res.*, 99, A10, 1994:

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Middle- and low-latitude emissions from energetic  
neutral atom precipitation seen from ATLAS 1 under  
quiet magnetic conditions

B. A. Tinsley,<sup>1</sup> R. P. Rohrbaugh,<sup>1</sup> M. Ishimoto,<sup>2</sup> M. R. Torr,<sup>3</sup> and D. G. Torr<sup>4</sup>

**Abstract.** During the ATLAS 1 mission spectral observations were made at middle and low latitudes of features expected from the precipitation of energetic neutral atoms. The Imaging Spectrometric Observatory was used at night in the UV and visible with maximum gain. The tangent ray heights of the look directions ranged from near 100 km to near 200 km, and the geomagnetic conditions were quiet during the observations, which were made March 28 to April 3, 1992. The  $N_2^+ 1N$  391.4-nm and O I 130.4 and 135.6-nm emissions were observed at all latitudes, with lower emission rates at lower magnetic dip latitudes, except that enhancements in the O I lines were seen within 30° of the dip equator due to radiative recombination of ionospheric plasma. The latitude profile observed for the  $N_2^+ 1N$  emission did not show an equatorial or midlatitude peak. This implies that the source of energetic neutrals is more consistent with prompt charge exchange loss of freshly injected trapped ions with relatively low mirror heights (i.e., ions on higher  $L$  shells with equatorial pitch angle distributions nearly isotropic to the loss cone) than loss of highly eroded populations of particles with high mirror heights (i.e., ions on lower  $L$  shells with pancake equatorial pitch angle distributions). The  $N_2^+ 1N$  emission rates have been compared with models of atmospheric emission due to fluxes of  $O/O^+$  and  $H/H^+$  in the thermosphere, as produced by energetic neutral oxygen or hydrogen atom precipitation. Energy deposition rates are inferred that range from about  $12 (\pm 3) \times 10^{-4}$  erg  $cm^{-2}$   $s^{-1}$  near 45° geomagnetic latitude to about  $3 (\pm 1) \times 10^{-4}$  erg  $cm^{-2}$   $s^{-1}$  near the geomagnetic equator. These can be compared with energy deposition rates a factor of  $10^2$  higher during magnetic storms.

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2. Spectra of Upper Regions of Quiet Time Aurorae, seen in the UV and Visible from ATLAS 1, Tinsley, B. A., M. Ishimoto, R. P. Rohrbaugh, G. J. Romick, M. R. Torr, and D. G. Torr, submitted to *J. Geophys. Res.*, currently being revised, 1994:

**Spectra of Upper Regions of Quiet Time Aurorae,  
Seen in the UV and Visible from ATLAS 1.**

B. A. Tinsley<sup>1</sup>, M. Ishimoto<sup>2</sup>, R. P. Rohrbaugh<sup>1</sup>,  
G. J. Romick<sup>3</sup>, M. R. Torr<sup>4</sup>, and D. G. Torr<sup>5</sup>.

Spectral observations were made on the NASA ATLAS 1 mission near 300 km altitude and in the vicinity of the southern auroral zone, looking towards the limb under quiet geomagnetic conditions on March 26 - April 1, 1992. The Imaging Spectrometric Observatory (ISO) was utilized for these measurements as part of the ENAP (Energetic Neutral Atom Precipitation) experiment, with simultaneous observations from three of its spectrometers. Spectra were obtained with relatively high resolution (~0.3nm) from six displays of faint and mostly diffuse aurorae, when the lines of sight were directed northward (equatorward) (5), and to the northeast (1). Features measured in the range 130 nm - 800 nm are compared with the outputs of model electron and ion codes, with inputs based on measurements made during a near coincidence with a DMSP spacecraft on March 30. The spectra mostly represent emission from above the height of peak energy deposition. The results include a unique set of auroral spectra of faint emissions from the upper parts of aurorae, and show vibrational and rotational temperatures characteristic of relatively high altitudes. Also seen were 'hot' O<sub>2</sub>Atm bands, due to excitation transfer from the relatively high concentration of O<sup>1</sup>D.

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There have not been any inventions made in the course of this work. The spectral images obtained during the observations on the Atlas orbiter have been processed and calibrated and forwarded to the NSSDC for archival.